PXD9 wafer-level testing plans

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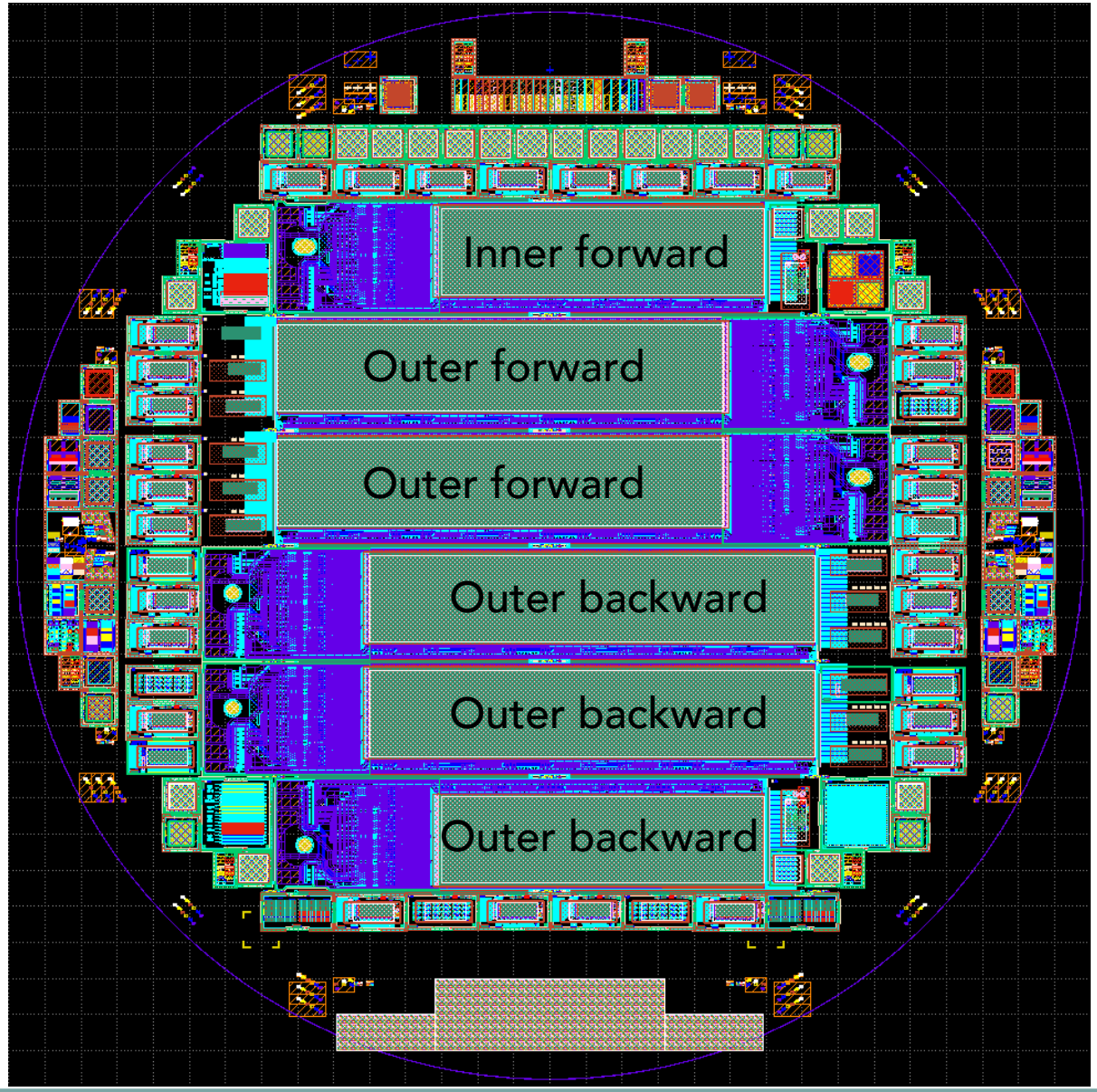
Outline

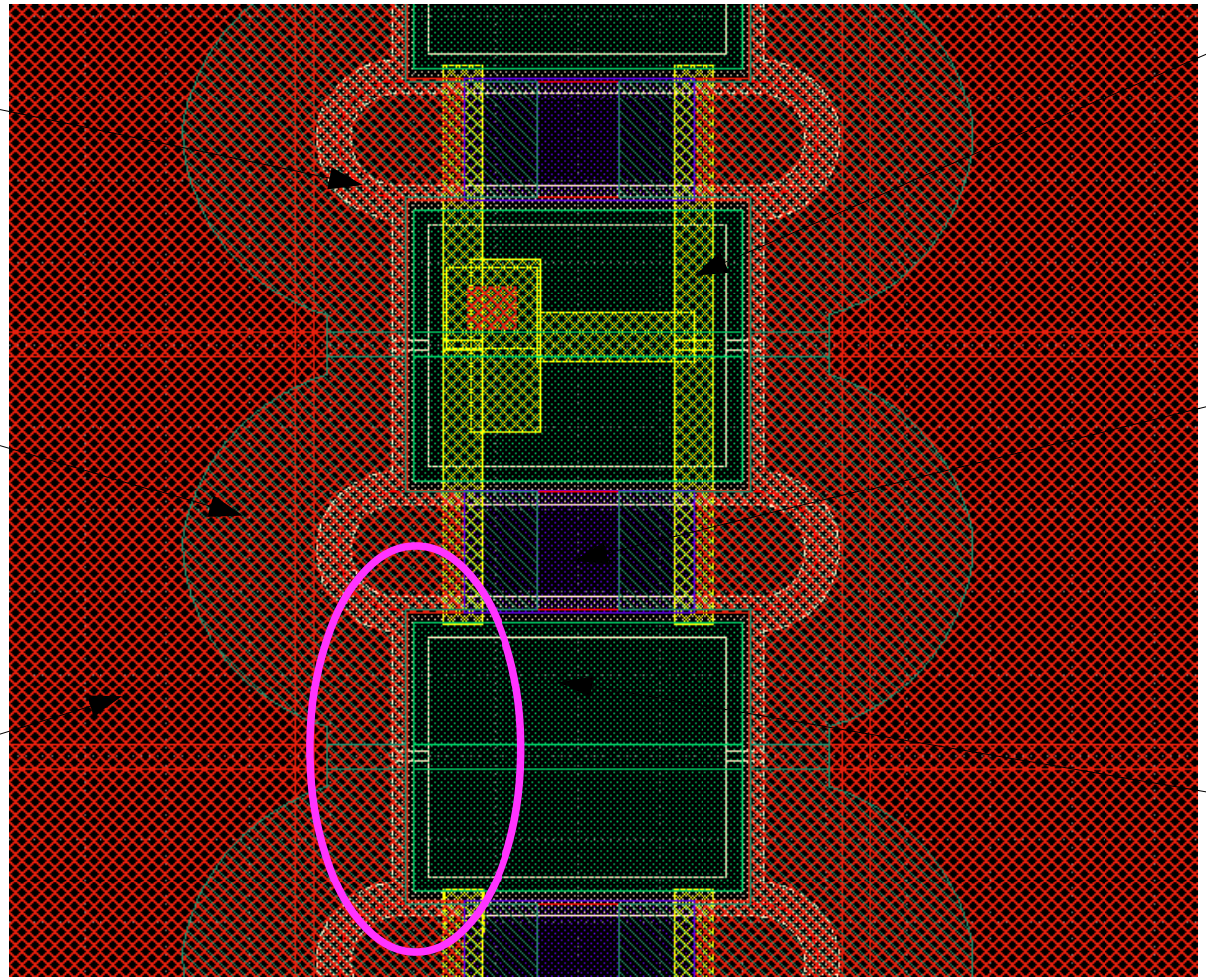
- Tests after first Aluminium layer
- Tests after second Aluminium layer
- Test setup for the test on the second Aluminium
- Summary and conclusions

The PXD9 wafer layout



Part I

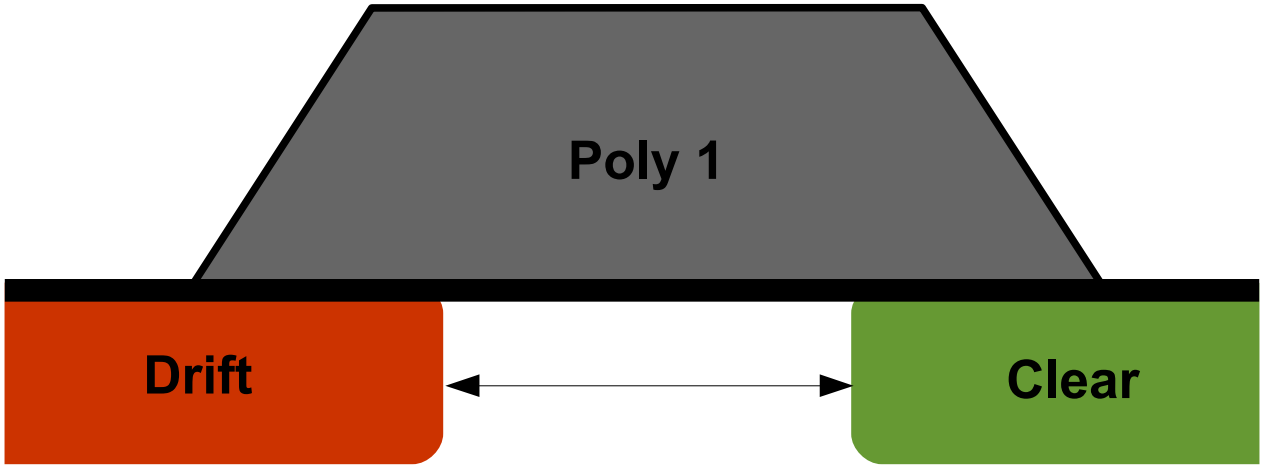
Test concept after first Aluminium [I]



Top view before metal 1

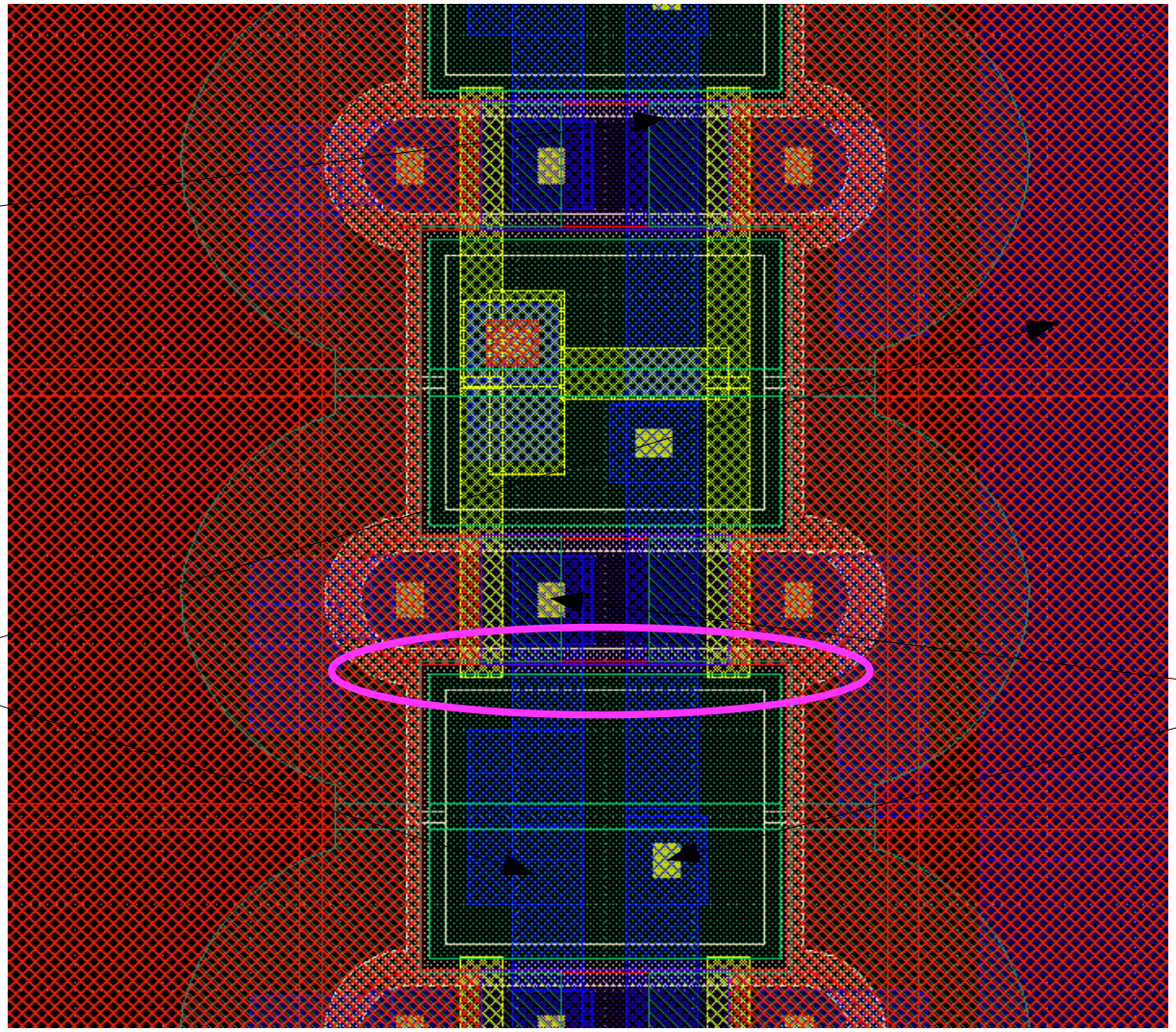
Clear – drift shorts

Side view



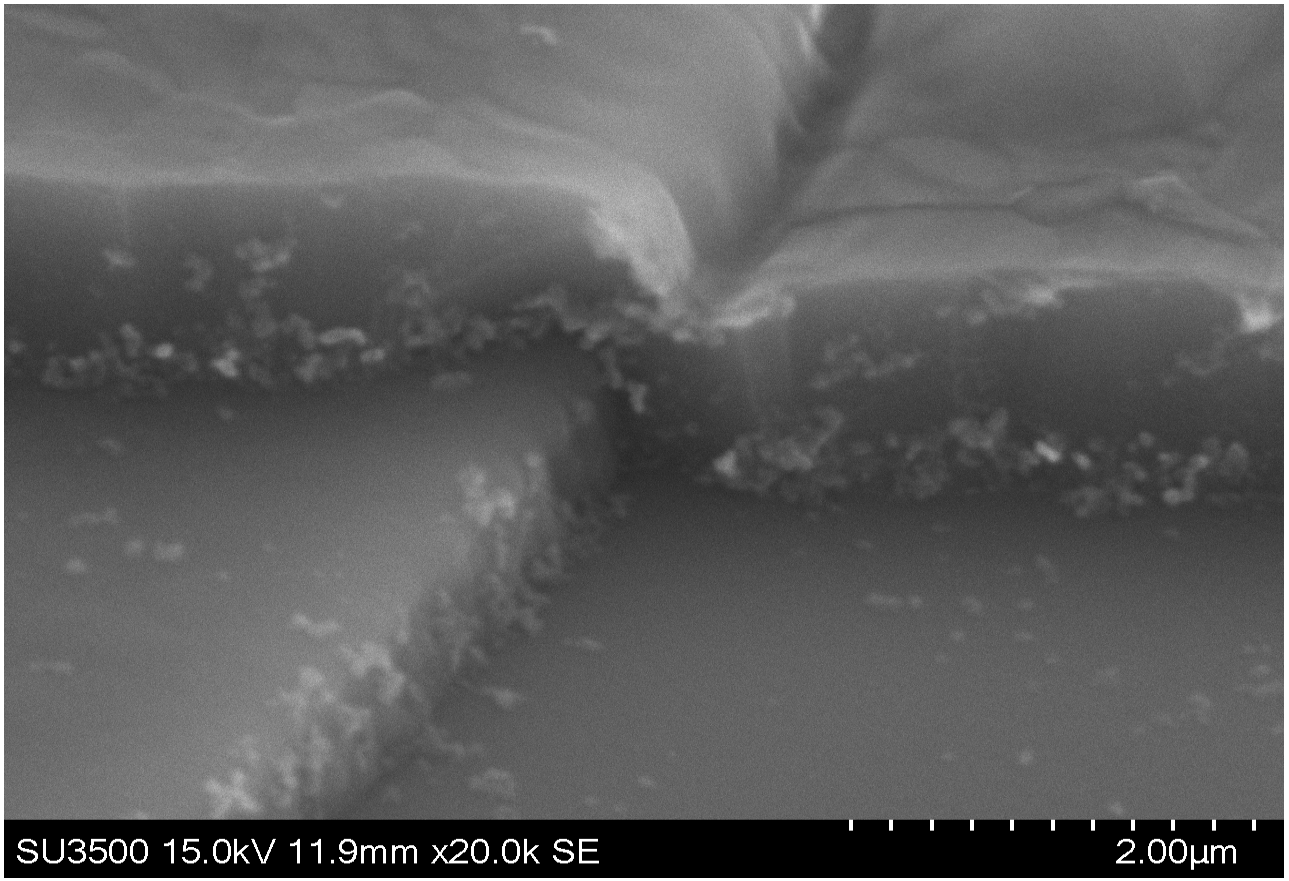
- Poly1 used as a mask for the implantation of clear and drift
- poly 1 not properly structured → possible shorts between n-type and p-type regions

Test concept after first Aluminium [II]



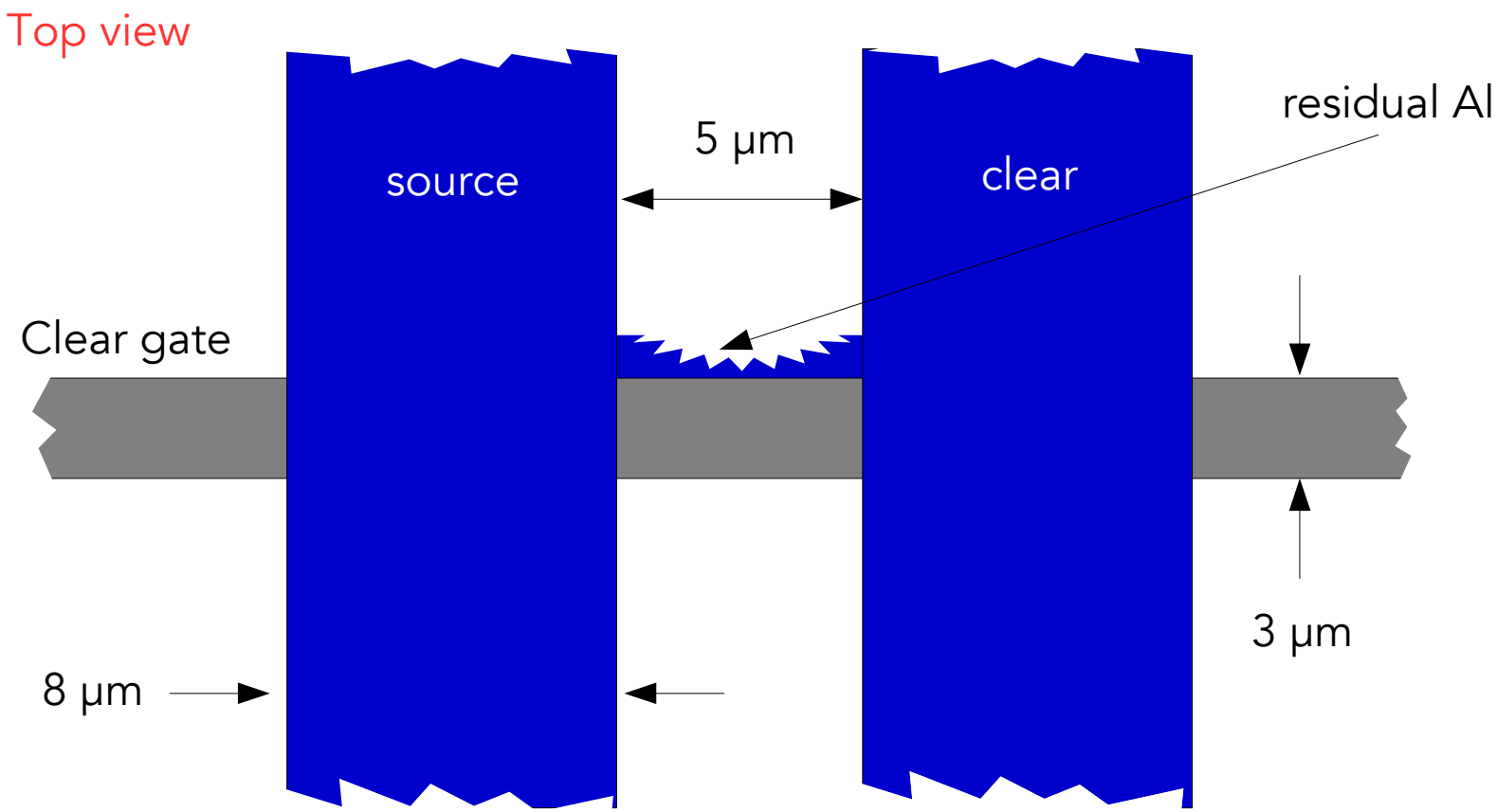
Top view after metal 1

Lateral shorts [I]



SEM picture of an Aluminium line climbing over polysilicon

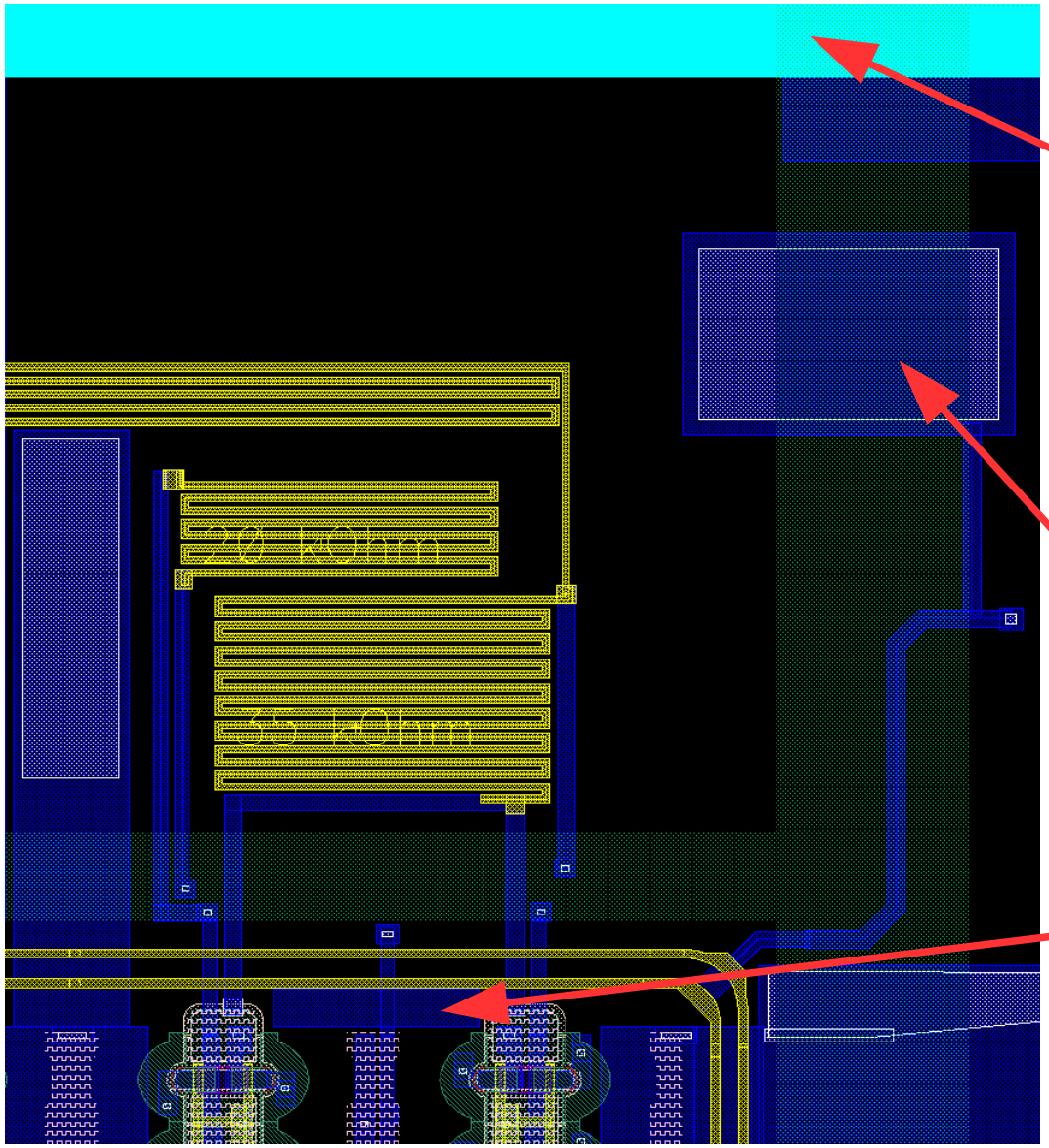
Lateral shorts [II]



Source and clear Al lines climbing clear gate poly-silicon lines

➔ possible lateral shorts due to bad metal etching over the poly step

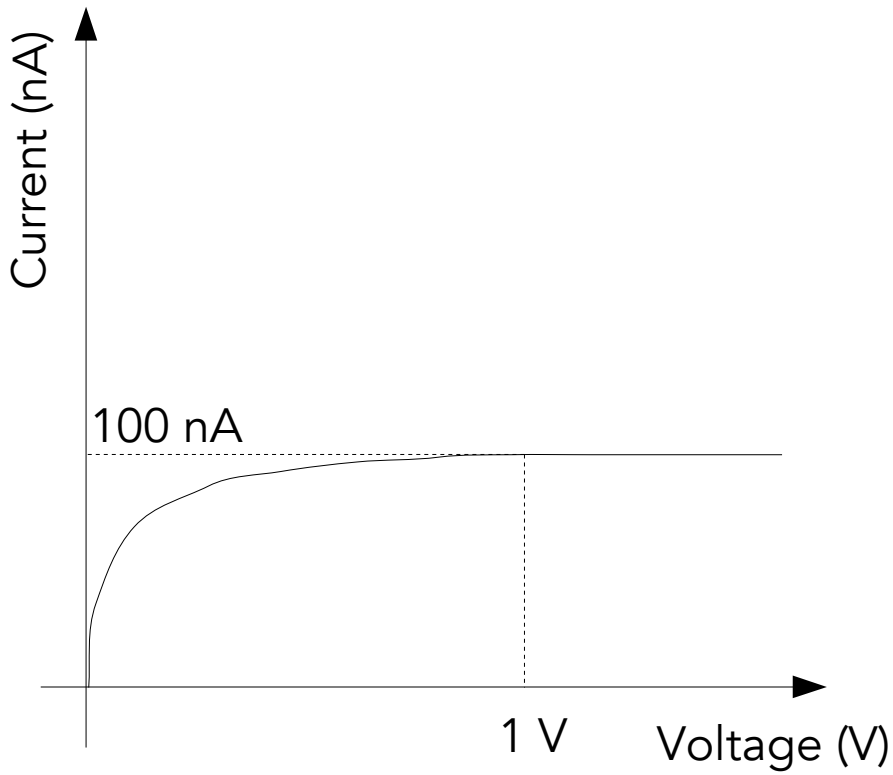
Test setup

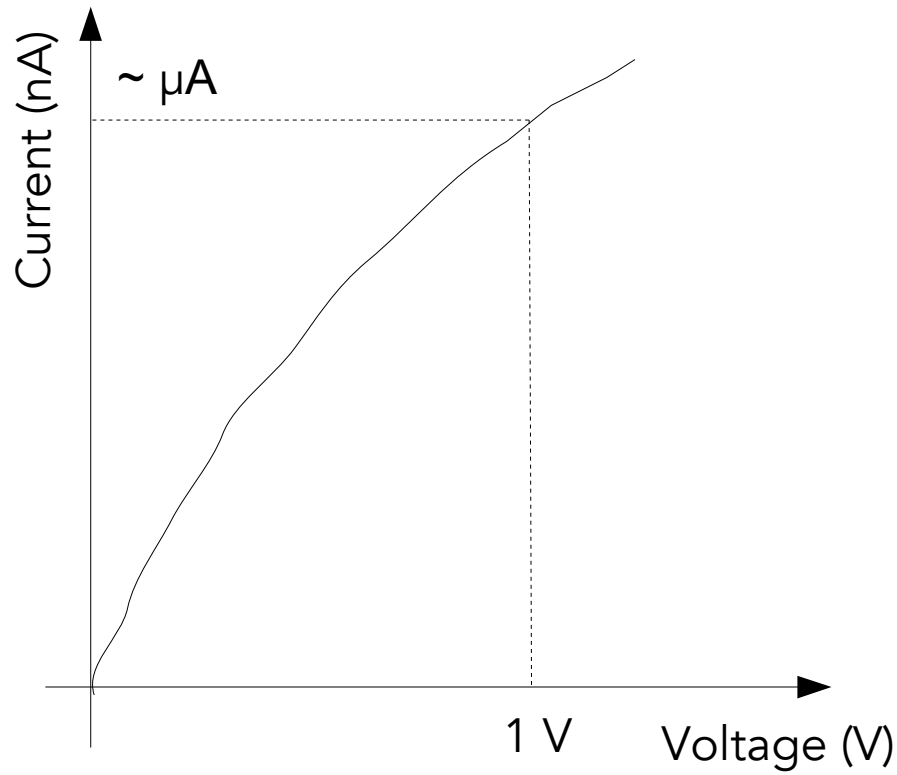


Cutting edge
Connected to n-type silicon
(bulk → clear)

Al1 pads
Connected to p-type silicon
(drift → drain → source)

What we do expect...





Reverse diode characteristics
➔ no lateral shorts or shorts between p and n-type Si

Presence of shorts
➔ difficult to discriminate of which nature only from IVs

→ BUT fundamental to have first yield results and the possibility to repair after Al1

Part II

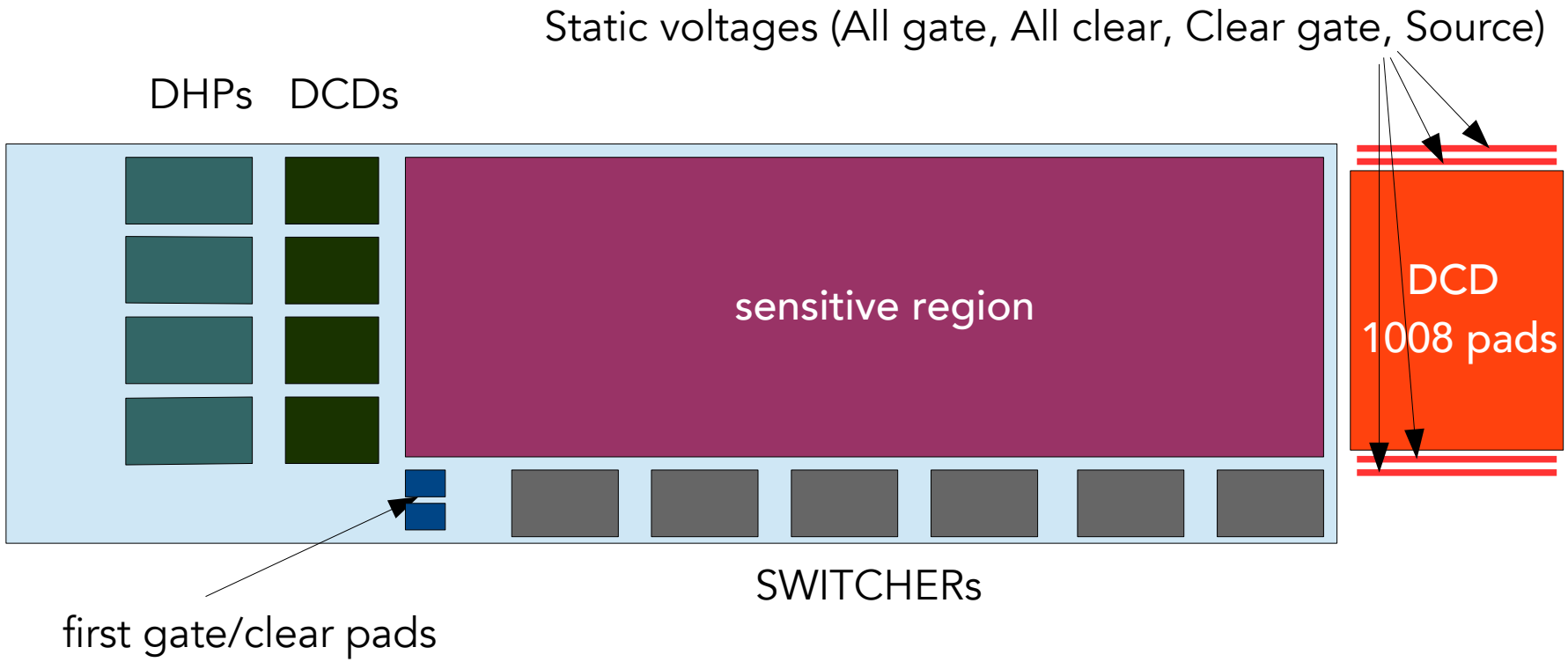
Test concept after second Aluminium [I]

Drain lines routed in Al2 very narrow (7 μm) and closely spaced (3 μm) ➔ probability of lateral shorts
Drain lines very long (>4 and >6 cm for inner and outer modules) ➔ probability of discontinuities

Measuring transfer characteristics of single transistors on the same geometrical row allows the detection of lateral shorts ➔ current value multiple of the single transistor

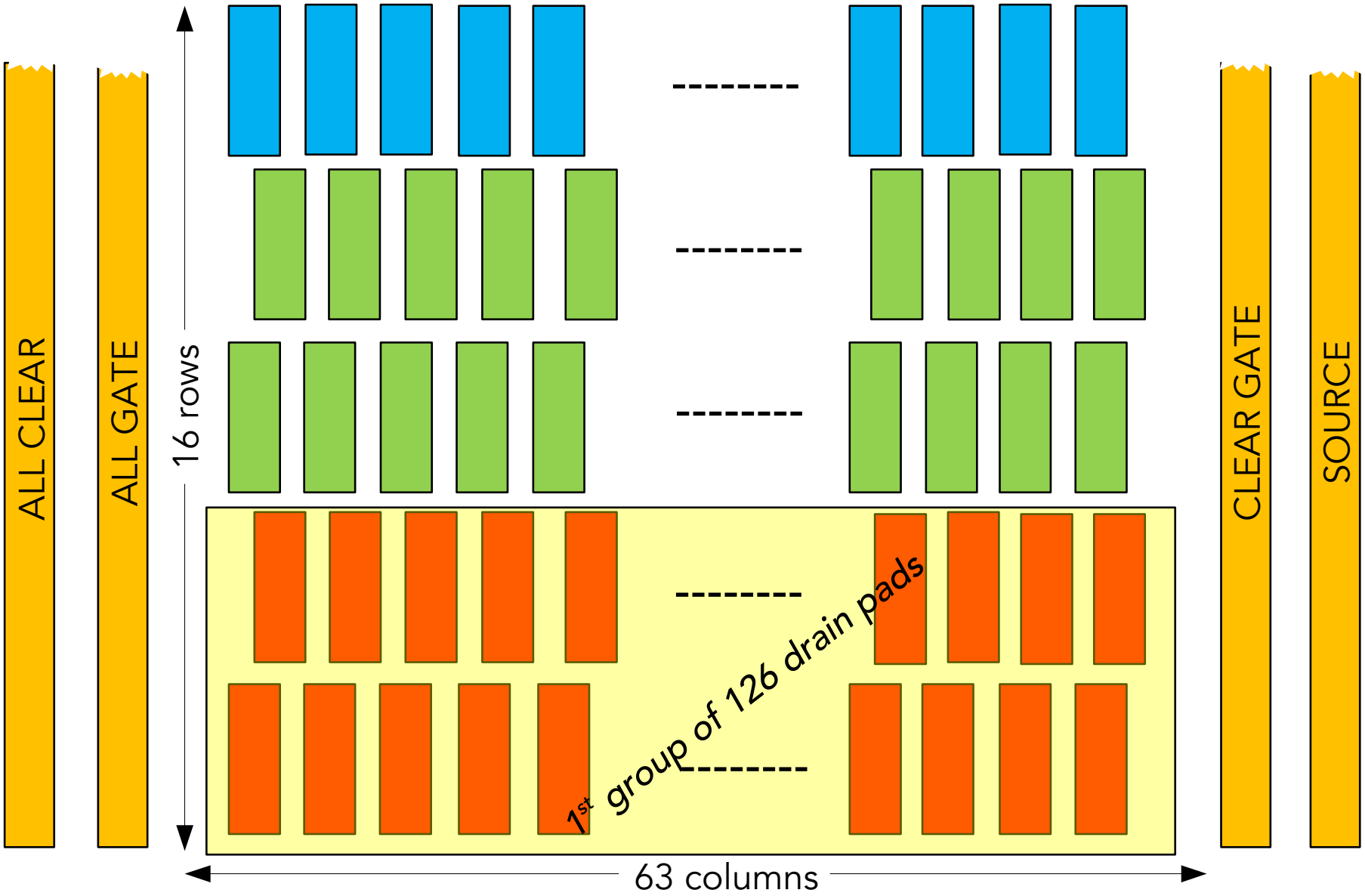
Develop a system to probe all the 1000 pads connected to the drain lines (one electrical row) ➔ probe card with switching system for high speed measurements

Top view of a PXD9 module (before Cu)



- Additional 1008 (8 redundant) Al2 pads routed in Al1 are added at the end of the matrix to avoid probing on the DCDs bump bond pads
- Organized in 16 rows of 63 pads each. Two long Al2 stripes for the static voltages available at each side of the fanout
- Fanout cut after testing and before Cu deposition

Test concept after second Aluminium [II]



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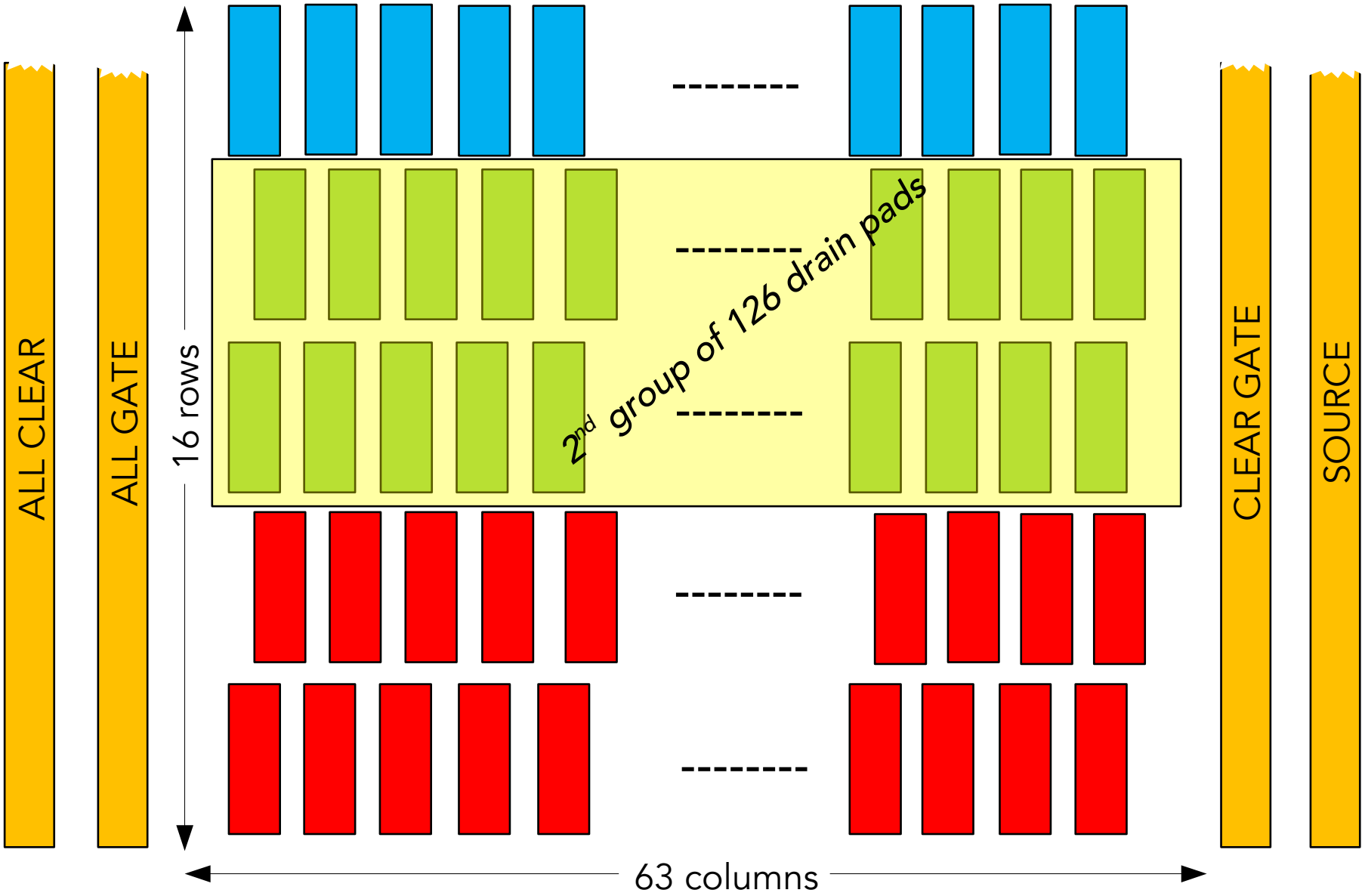

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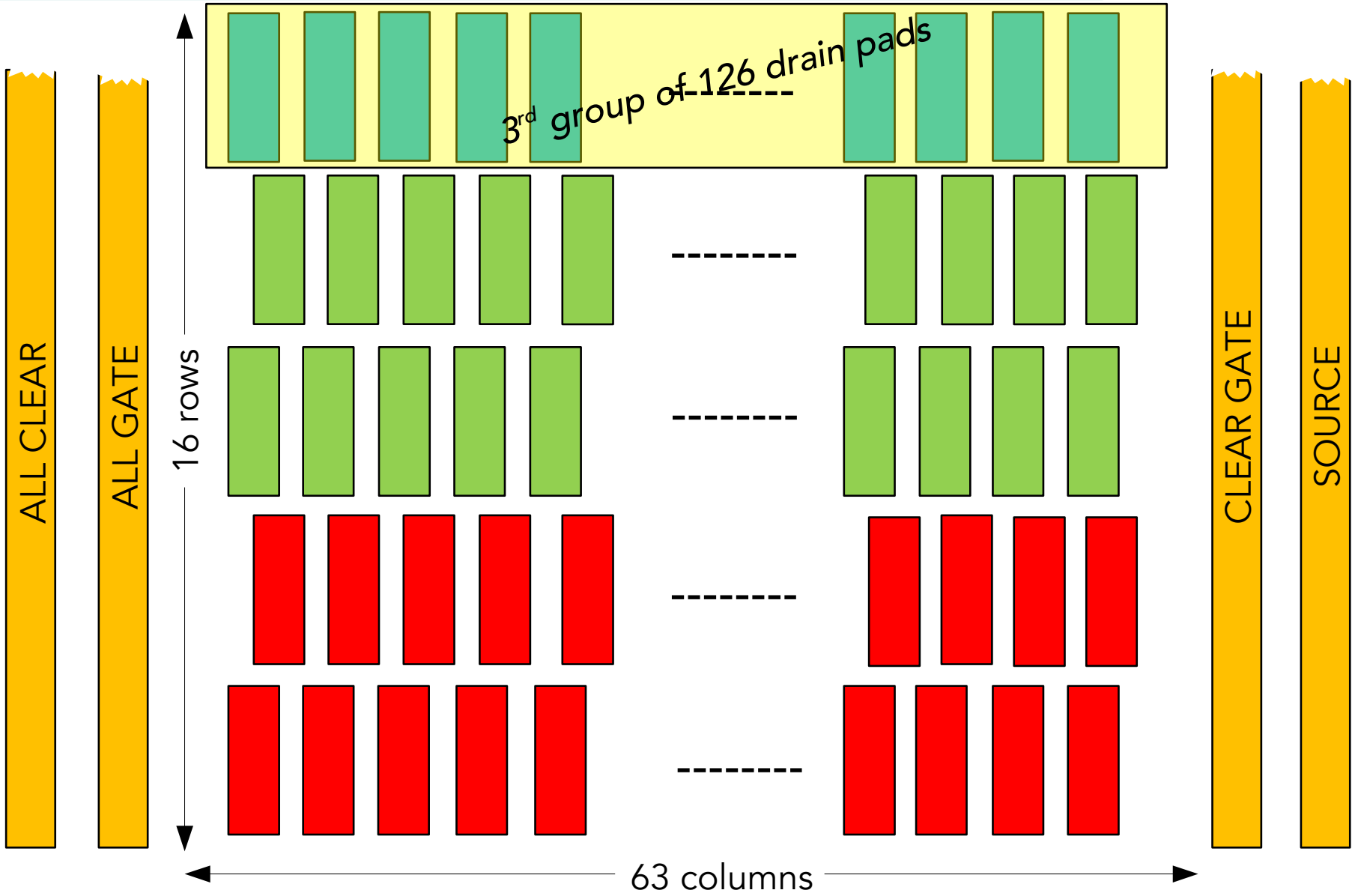
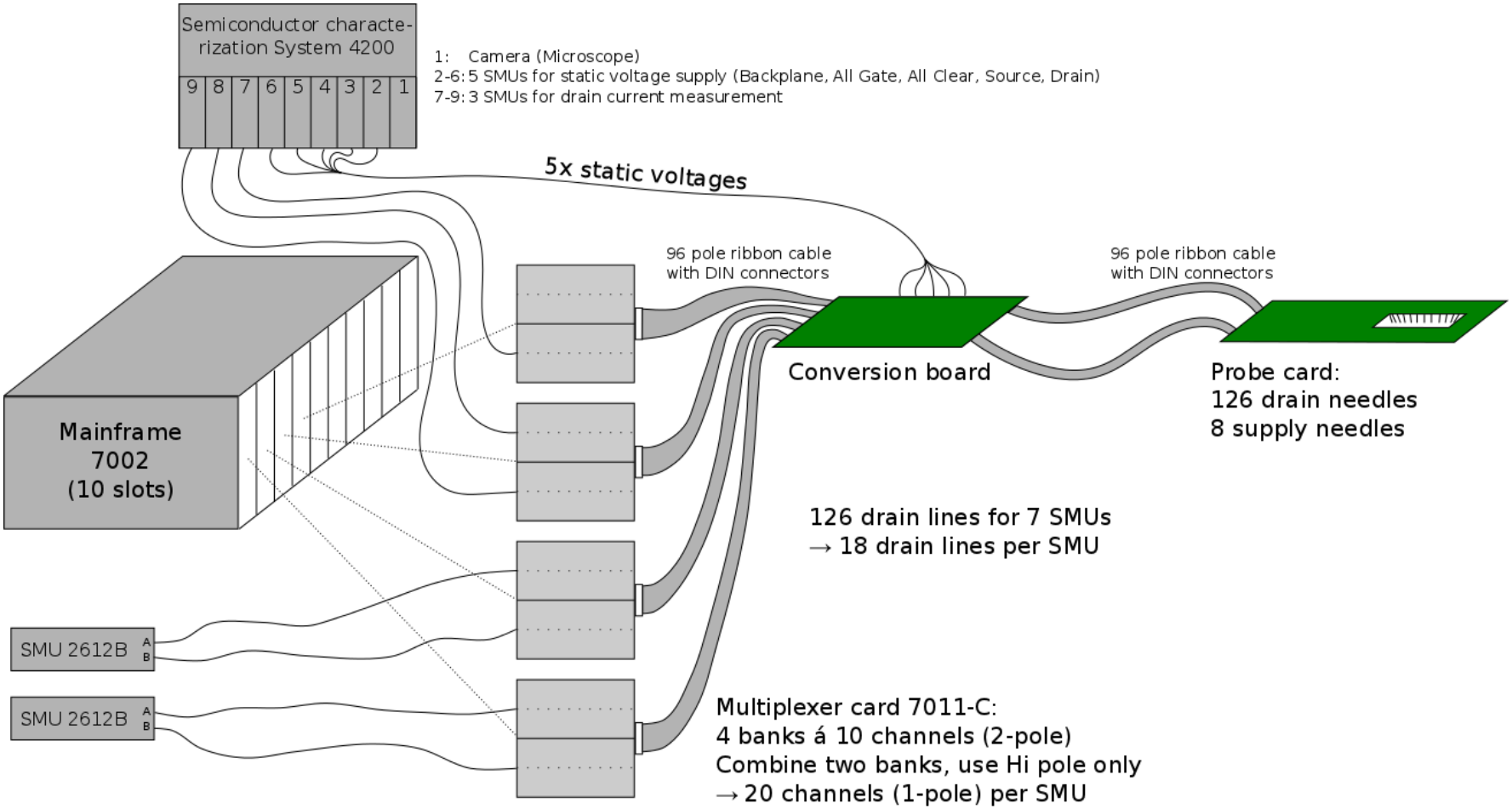


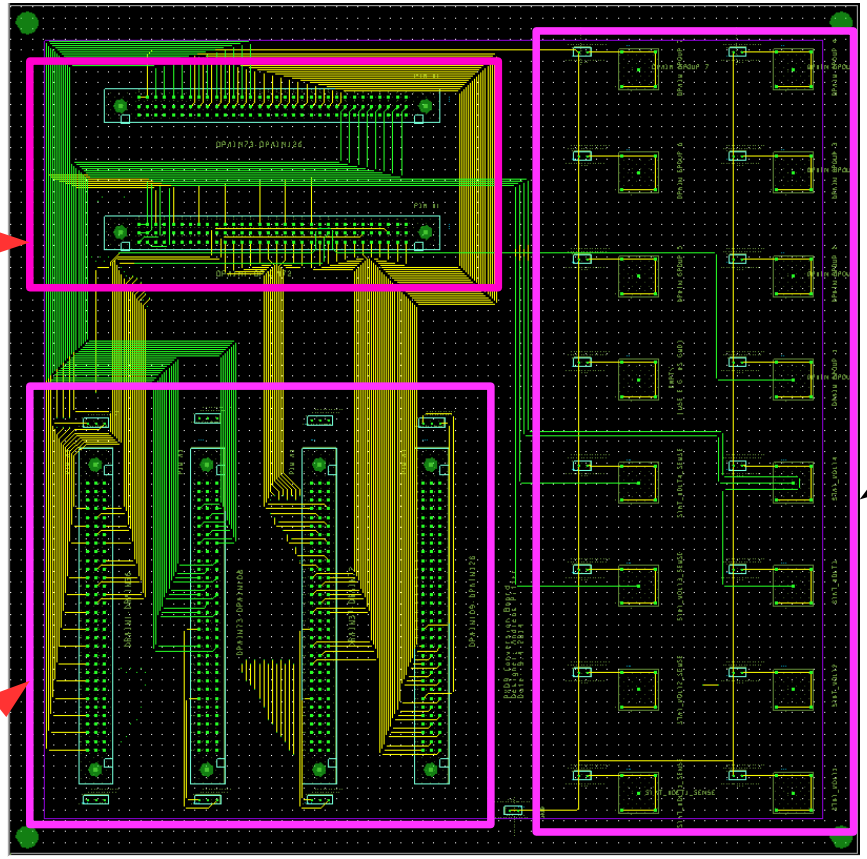
The testing system



Courtesy of Manfred Valentan

The conversion board

2 x 96 pin
DIN connectors
➔ to probe card



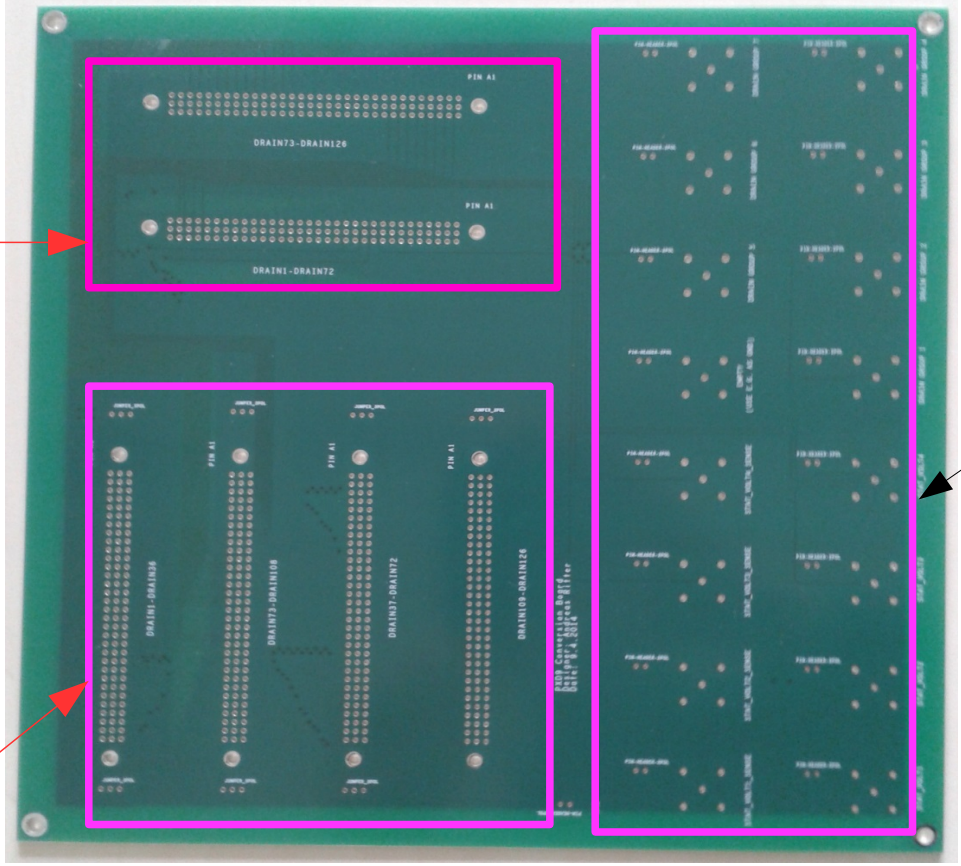
16 x BNCs
Static voltages
from Keithley
(switching)
system

4 x 96 pin DIN connectors
➔ Keithley switching system

Developed in four layers

The conversion board

2 x 96 pin
DIN connectors
➔ to probe card



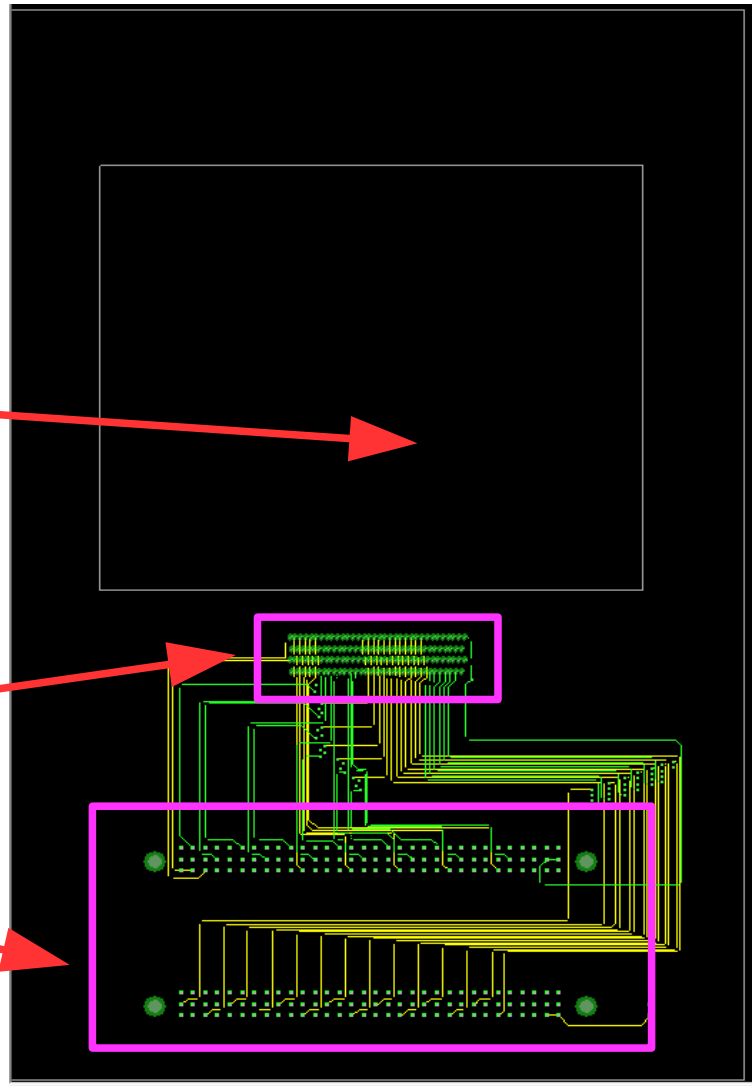
16 x BNCs
Static voltages
from Keithley
(switching)
system

4 x 96 pin DIN connectors
➔ Keithley switching system

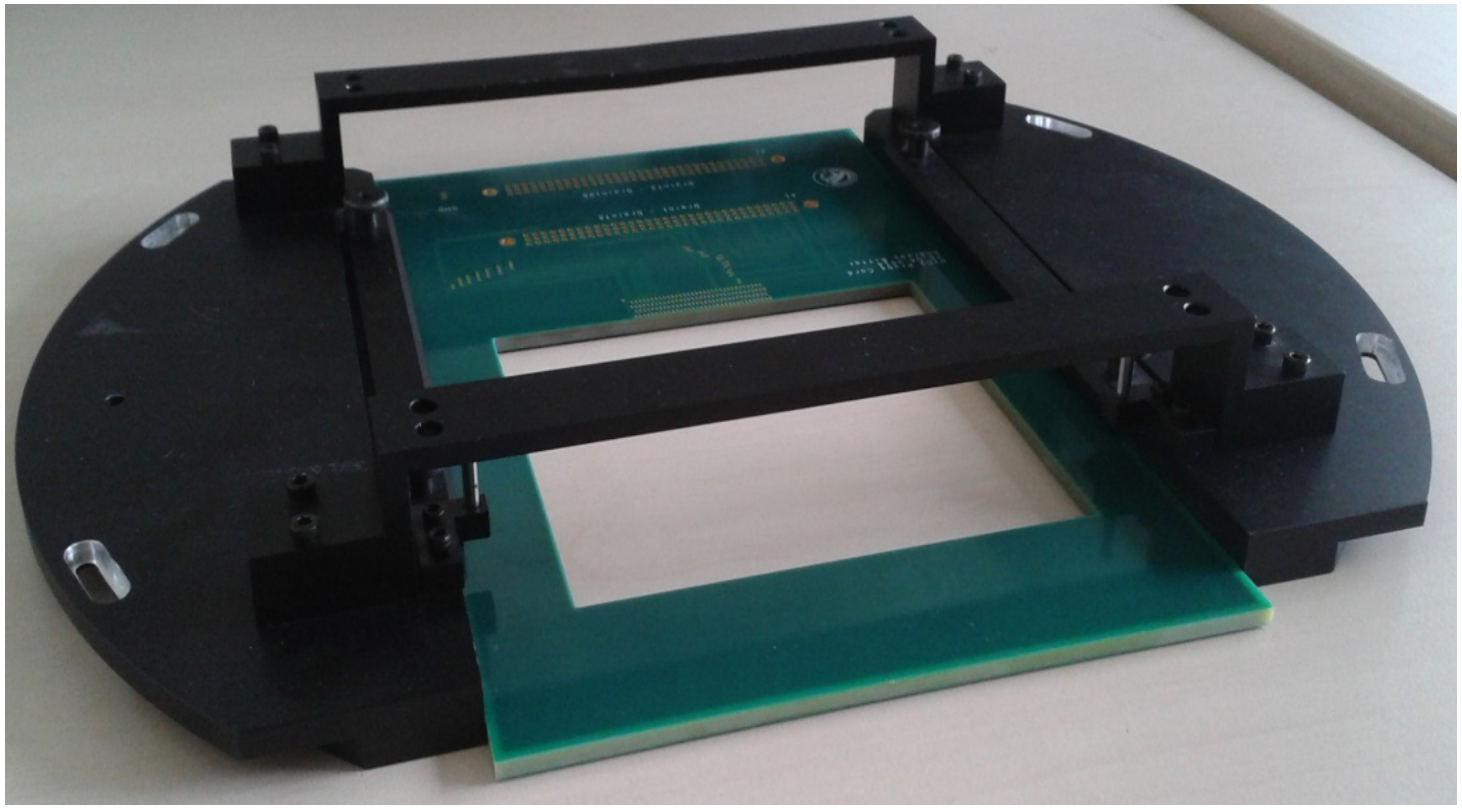
Developed in four layers

The probe card [I]

- Developed in eight layers
- Opening for the semi-automatic needle ➔ first gate row
- Pads for the 134 needles
  - 126 for drain lines
  - 8 for static voltages (4 of which used as sense needles)
- 2 x 96 pin DIN connectors



The probe card [II]



Probe card mounted in the probe card holder

Summary and conclusions

- Tests after Al1 are useful to verify presence of lateral shorts and shorts between p and n type implantations and therefore fundamental to have first yield results and possibility to repair after Al1

- Tests after Al2 allow detection of shorts between neighbouring drain lines (routed in Al2)

- The test setup for the test after Al2 involves the use of a probe card used in combination with a switching system for high speed measurements

- The PXD9 modules will be afterwards processed with Cu and therefore cut. Testing of the cut modules at the ATG probe station will allow the detection of failures in the metallization (cf. A. Ritter's talk)

Thank you!